

AbstractID: 13594 Title: Effects of Target Replacement on Helical MVCT Images for Use in Adaptive Radiotherapy

Purpose: To investigate the effects of target replacement on helical mega-voltage CT (MVCT) images for use in adaptive radiotherapy.

Method and Materials: CT number to density tables were measured for three helical tomotherapy systems at two separate institutions. For each machine, MVCT images and measurements were acquired before and after their respective beam targets were replaced. Phantoms containing removable plugs having known physical densities between 0.6-1.8 g/cm³ were imaged on the helical tomotherapy imaging systems. Physical densities were collected from phantom specifications, and CT numbers were recorded from regions of interests consistently drawn within each phantom plug. Phantom and clinical MVCT images before and after the target replacements were compared.

Results: For all three machines, target replacements affected CT number to density tables. In the density range of water, CT numbers before and after target replacement differed by 45, 105, and 56 HU for Machines A, B, and C, respectively. The post-target replacement CT number to density tables for Machines A and B were extremely similar to each other. Images acquired after the target replacement showed qualitative improvements in image quality.

Conclusion: The helical tomotherapy imaging system is affected by major hardware changes, which is evident from measured changes in CT number to density tables before and after a target replacement. If MVCT images are used for treatment planning, these images should be monitored with at minimum an equivalent quality assurance program as for conventional CT simulators. In order to reduce dosimetric uncertainties when using these images for treatment planning or adaptive radiotherapy, the integrity of the CT number to density table should be monitored more rigorously in the presence of machine repairs or instabilities.